Design of in-vivo Biomarker applicator modules for detecting cervical cancer and cervical anomalies

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Abstract: Technology has proven to be a driving force in changing the society of the developing Nations like India. Biomedical Technology is one of those various applications areas. Women in remote areas of the country are subject to lack of adequate healthcare facilities and specialist doctors. One of the most common forms of cancer in women worldwide is Uterine Cervical Cancer. Mostly the cases of cervical cancer can be prevented through the screening programs by detecting tissues which are precancerous, which have suffered or been damaged by any disease/injury. Due to less gynecologists and due to their casual attitude, women are not treated early. It can turn out to be fatal. In this project, we have basically proposed an automated system which will detect the cervical cancerous cells which are used by trained health workers to detect affected people in remote locations. On detection of the lesions by the system, the affected patients may be called to the cities for further treatment by the specialist doctors.

***Index Terms* - Cervical Cancer, sensors, 2D image, automation.**

I. Introduction

Cervical cancer is a type of cancer occurring in women's body part called cervix. Cervical cancer is the second most common cancer among women in India and accounts for around 70000 deaths per year with around 75 percent occurring in rural areas. With less number of specialized doctors in rural areas it has become imperative to develop a system which can predict cervical cancer especially during pre-cancerous stage so as to reduce the number of death counts especially in rural areas .This problem can be solved using system which uses Computer Vision along with Deep Learning. In this work the challenge is to maintain high specificity and sensitivity which is extremely crucial in medical sector along with identifying region in 2D image which contains cancerous part or symptoms of cervical cancer due to which further test would be recommended to be carried out along with integrating demographic data of patient along with image data so as to create an ensemble model which would result in better accuracy of system.

II. Literature Survey

Cervical Cancer is one of the most common forms of Cancer in women worldwide, and 80% of cases occur in the developing world including India, where very few resources exist for management [1]. Most cases of cervical cancer can be prevented through detecting precancerous cells with the help of screening programs. Screening to detect neoplasia in cervix, using the Papanicolaou (Pap) smear, and by usage of colposcopy, biopsy the mortality of cervical cancer has been dramatically reduced in every country where organized programs are available.[2]. The neoplasia detected in cervix can take 3 to 20 yr to develop into cancer. However, every year about 250,000 women die of cervical cancer due to lack of resources and infrastructure, most of it are occurred in developing or underdeveloped regions/countries [1] [3]. We are interested in replacing expensive infrastructure by applying optical technologies for cervical cancer screening in the developing world.

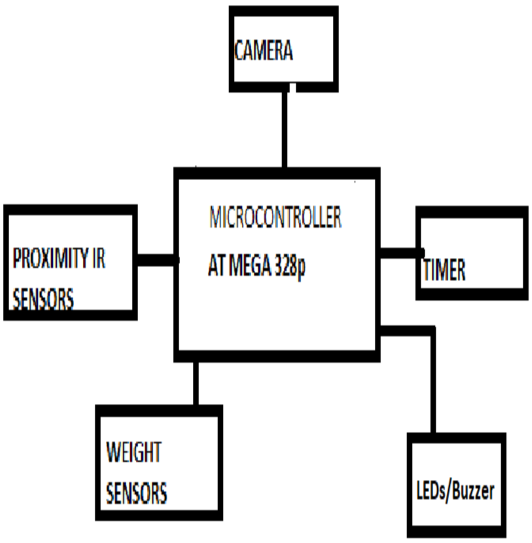
Recently, optical techniques have been discovered as an alternative to the available detection methods since several studies have demonstrated that optical spectroscopy improves the detection of neoplasia. Studies have been done for diagnosis of cervical neoplasia. It was successful in reporting a sensitivity of 94-97% and a specificity of 68-72%. Optical detection of HGSIL using fluorescence and reflectance spectroscopy, was successful in achieving a sensitivity of 90% and a specificity of 70%. Studies have discovered that when digital imaging system was used for colposcopy, it enabled capturing image and its processing simple. Studies have provided a vast information about the features that are widely useful to the expert observer. Interpretation of image in these early studies when digital imaging system came in relied mainly on experts' qualitative assessment of colposcopy images and provided limited quantitative analysis. Usage of colposcopy features such as aceto-whitening changes, lesion margin, and blood vessel structures was possible only after computer based diagnostic system came in . [4]. It used image processing algorithms for detection of those features and showed promising preliminary results. However, the diagnostic performance of the system has not been reported.

Recently, Due to advanced electronics, cheap, high-dynamic-range (CCD) cameras with excellent low light sensitivity have been on a radar. Also, the advances in vision chip technology enable high quality image processing in real time. Moreover,the cost of screening has reduced widely since automated analysis algorithms based on modern digital image processing techniques has replaced the clinical expertise .

Current procedure used for capturing of the images of the organ before and after applying of the chemicals leads to a lot of erroneous data. This is because of human errors that take place when executing this method such as application of wrong amount of chemicals, taking images at wrong instant of time, application of wrong chemical itself, and many such errors. Our device eliminates all of these errors by being fully automatic. For this purpose we have used a number of different sensors and mechanical actuators. The sensors used are proximity sensor, weight sensor and timer.

1. Automated System:

The probe we developed is used to capture photos of the pre-malignant changes that occurs on the skin layer of the upper cervix. These photos are then sent to our server and with the help of machine learning and computer vision, the level of cancerous presence is predicted.



•Camera: A camera is attached to LED lights. The purpose is for using it as a feedback sensor as well as live display

•Automatic Spraying Mechanism: A mechanical system is connected at the side of the probe to spray the required chemicals.

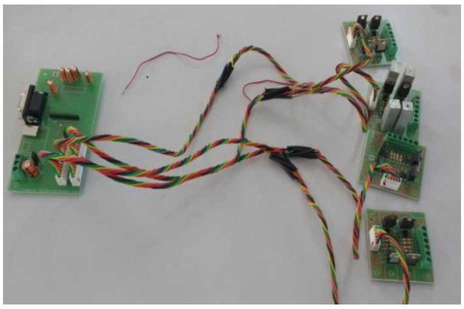
•Proximity Sensor: This sensor is used to place the probe accurately at a distance of 3-4 cms away from the layer of the skin at the lesion

•Timer: A timer is used to spray the chemicals at specific intervals and to capture the images at specific time.

•Weight Sensor: This is used to check the amount of chemicals at various time intervals.

•USB 3.0: The output images of the camera is then transferred to the android device for storage and machine learning.

Feedback Sensor: This Feedback Sensor is important as it can tell whether the chemical is actually sprayed, If there is blockage or is the automatic spraying mechanism working properly. Camera can also be used as a Feedback Sensor as it can detect whether the chemical is actually sprayed or not but it cannot detect how much chemical is sprayed. So a sensor which can detect the amount sprayed is the level measurement sensor.



2. Conclusion:

The sprayed chemicals sometimes suffers a backsplash on the camera lens which is undesirable as it is then very difficult to remove and clean the camera.

The amounts of the chemicals sprayed are sometimes not correct. Hence this leads to wrong results.

The time intervals between spraying the chemicals and the time intervals before clicking the photos varies in few cases. This leads to poor result generation.

Chemicals which is sprayed on the cervix wears off in a few minutes. Hence it is necessary to click photos and spray the next chemical at accurate time intervals for accurate results.

Presence of an android device with good network speed/ wifi is necessary.

III. Acknowledgment

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